

Cell Sheet Engineering with Intelligent Polymer-Grafted Surfaces

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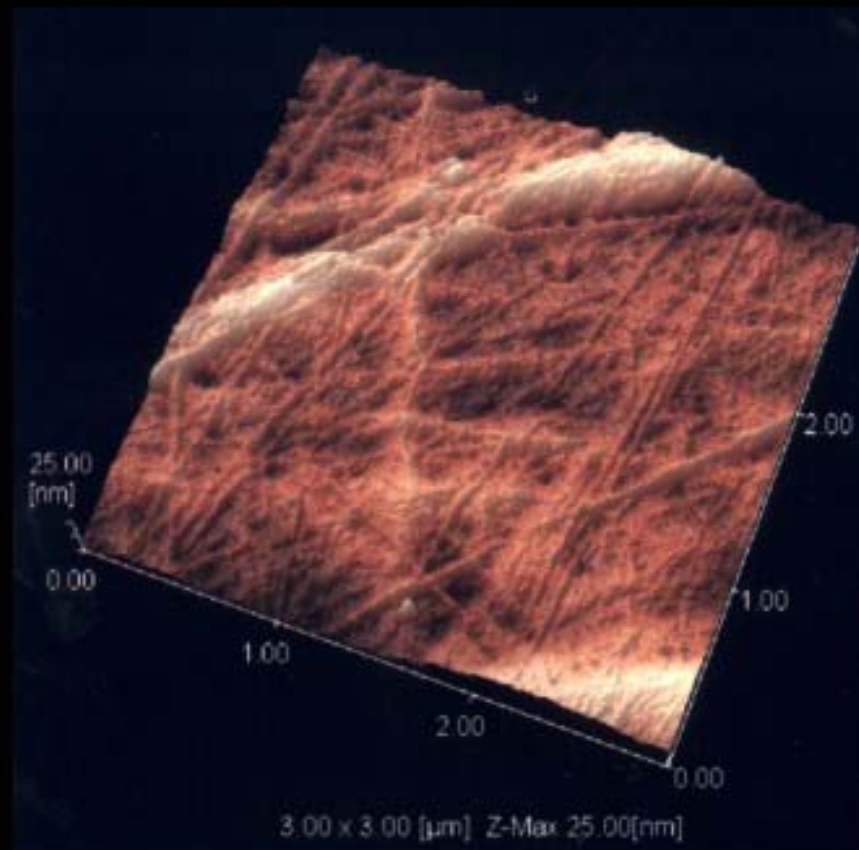
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Temperature-Responsive Culture Dish

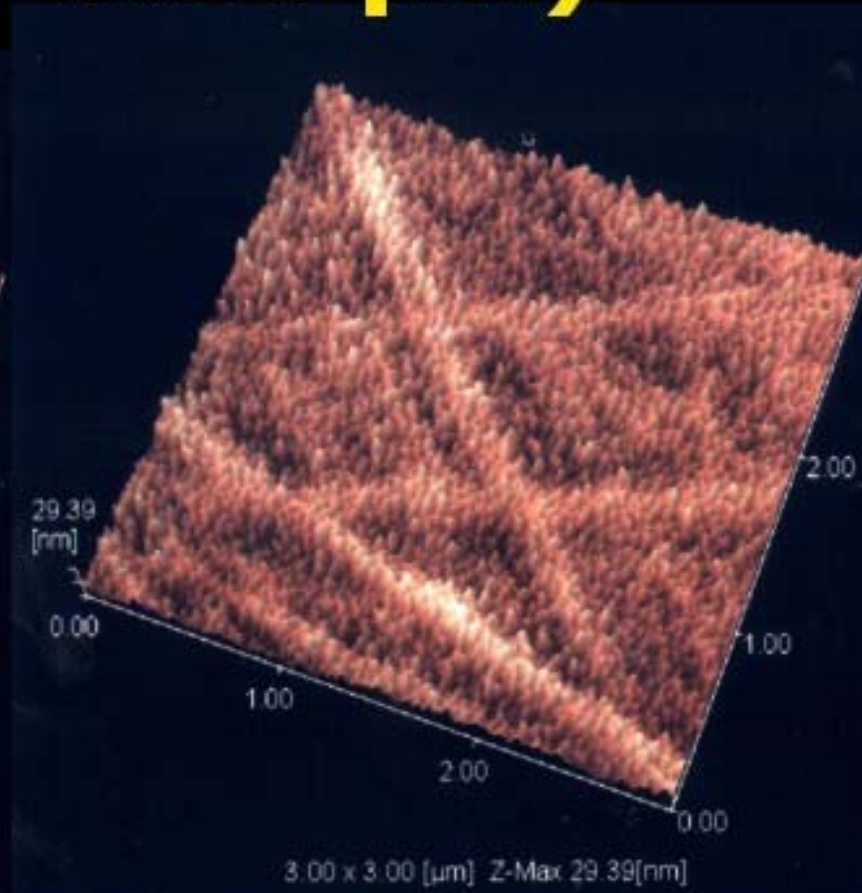
- grafted with temperature-responsive polymer, poly(*N*-isopropylacrylamide)
- 37°C hydrophobic ⇒ **cell attachment**
- below 32°C hydrophilic ⇒ **cell detachment**



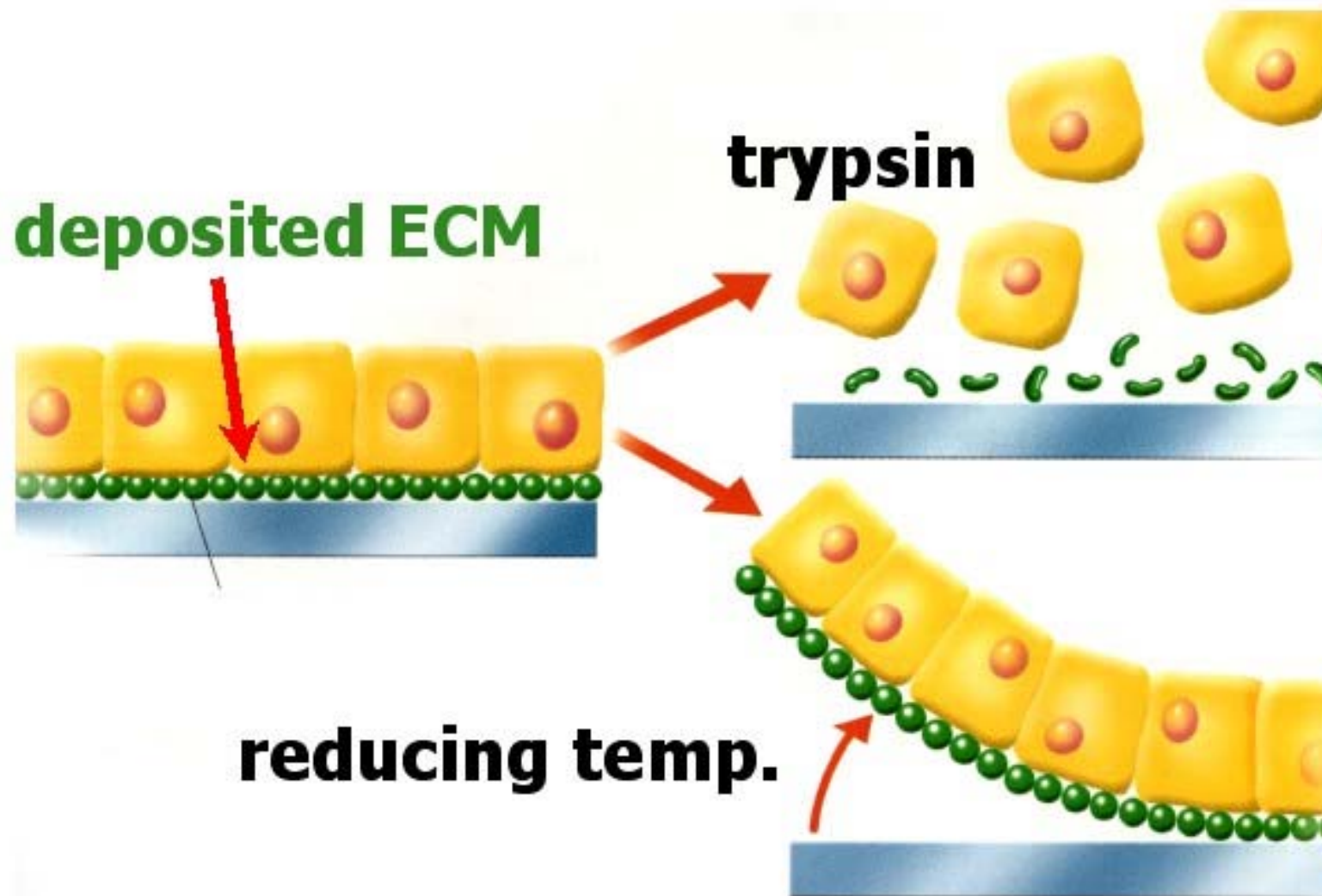
AFM ($3.00 \times 3.00 \mu\text{m}$)



TCPS



PIPAAm



Deposited ECM is recovered together with Cell Sheets.

Cell Sheet Engineering

Clinical Appl. Road Map



Single Cell Sheets

Skin Epithel, Cornea Epithel,

Cornea Endothel,

Retina Pigmented Epithel, Urothel

Periodontal Ligament

Homotypically Stratified Sheets

Cardiac Muscle

Heterotypically Stratified Sheets

Liver & Kidney Tissues

Eye

Cornea

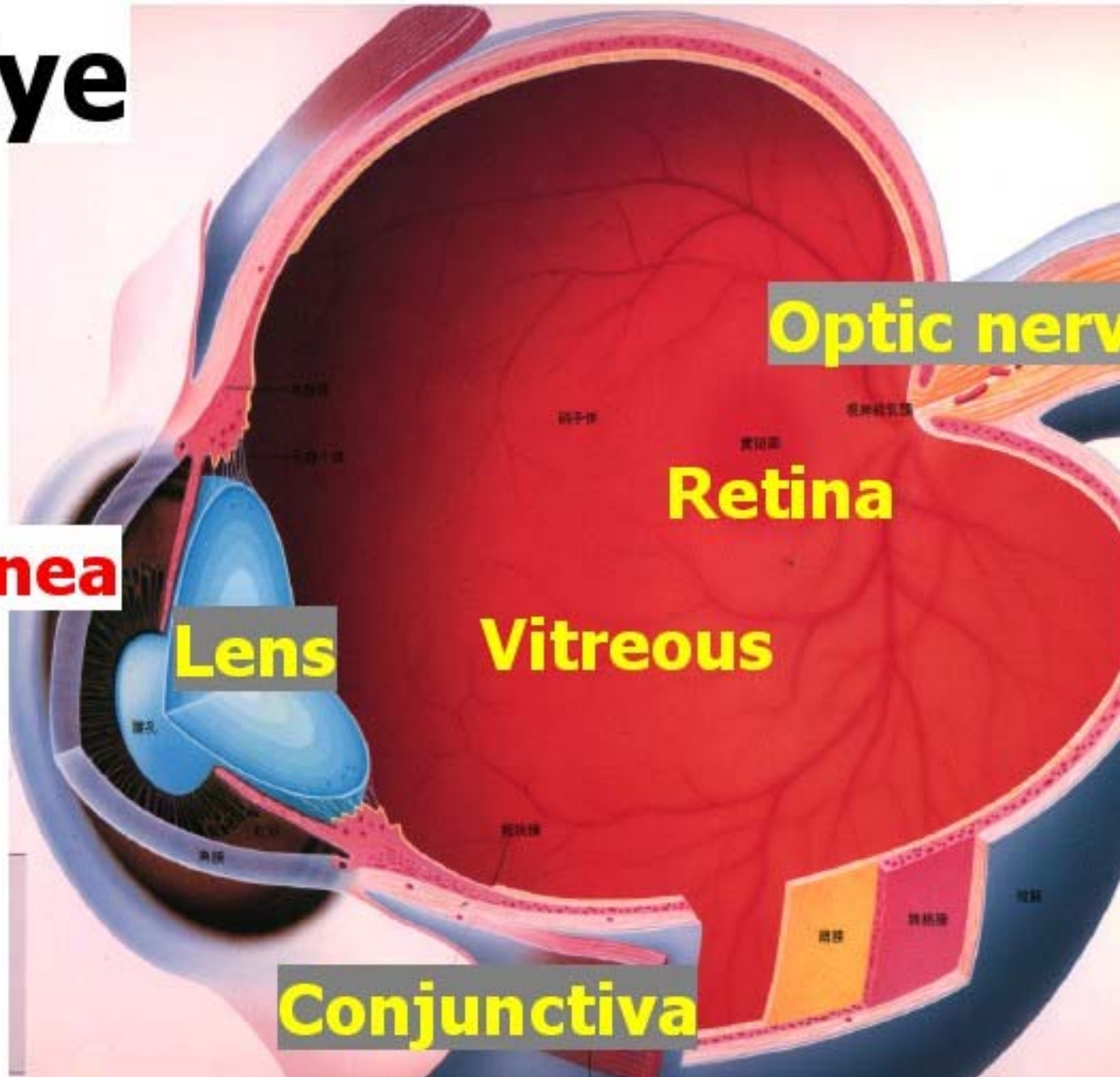
Lens

Optic nerve

Retina

Vitreous

Conjunctiva



***Organ/Tissue
Transplantation***

**Limited donor
Rejection**



**Tissue
Engineering**



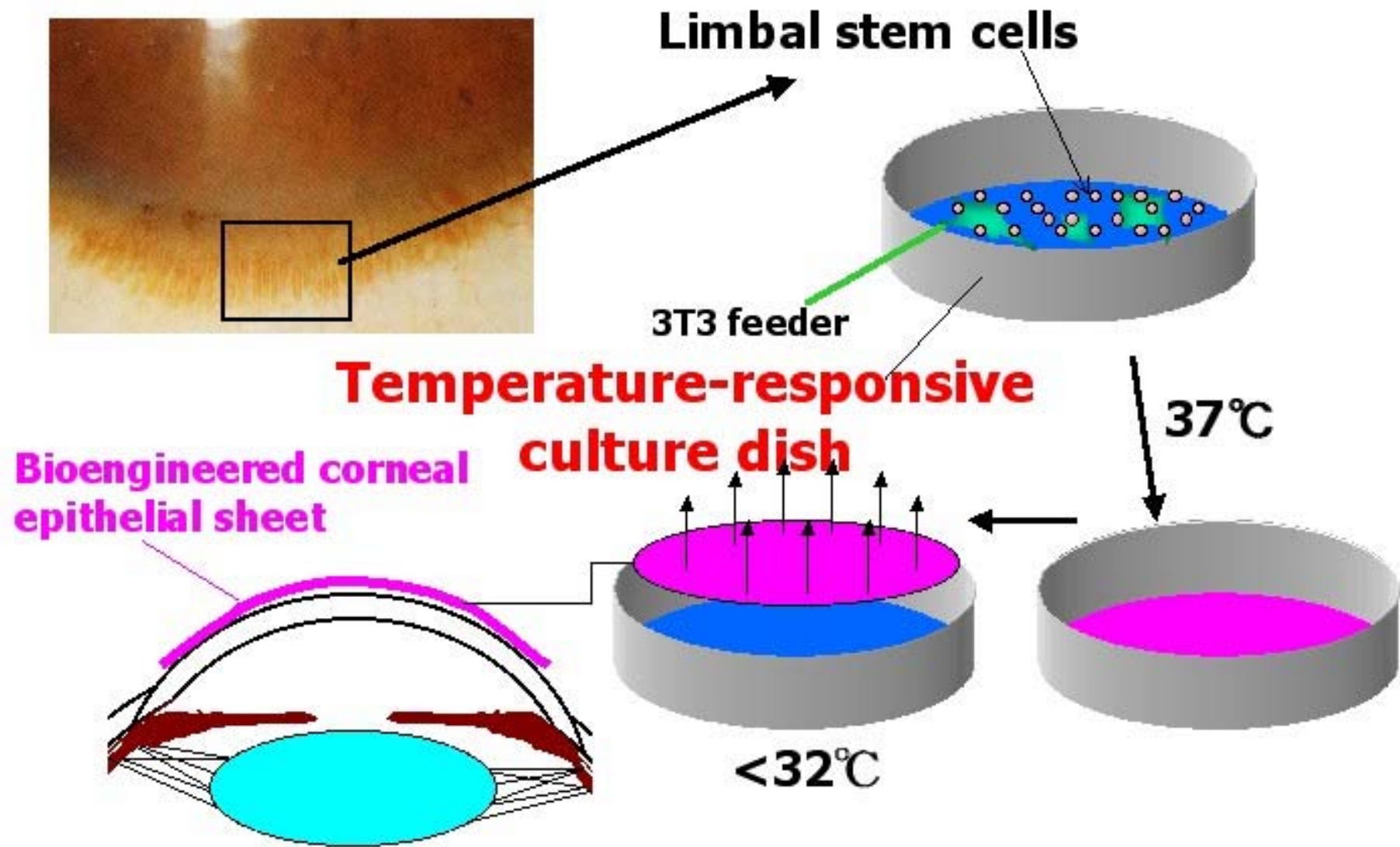
alkali injury



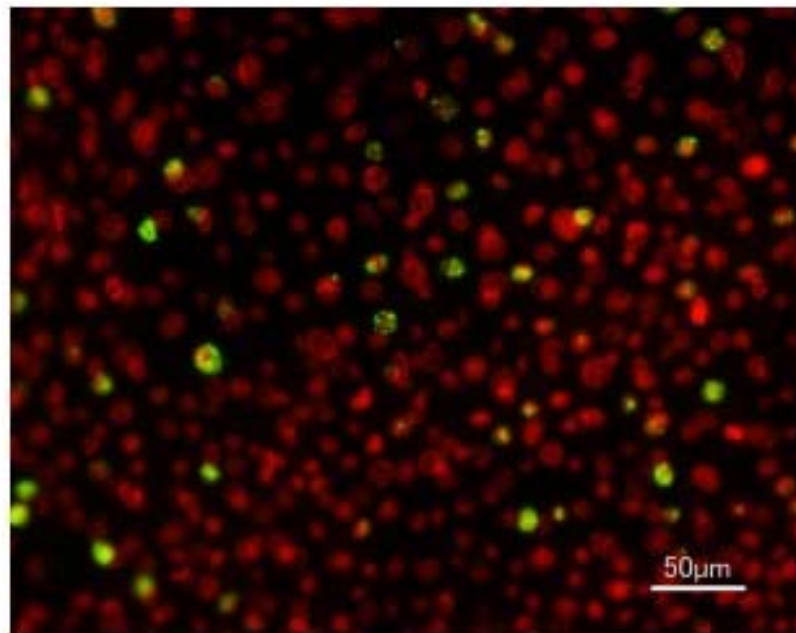
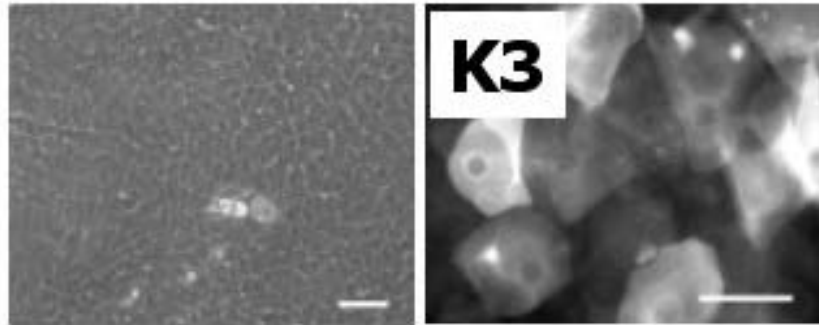
Stevens-Johnson syndrome

All the stem cells are exhausted.

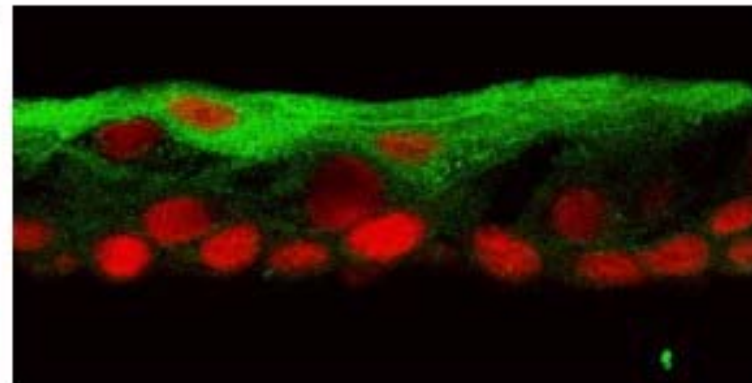
The Present Carrier-Free Method



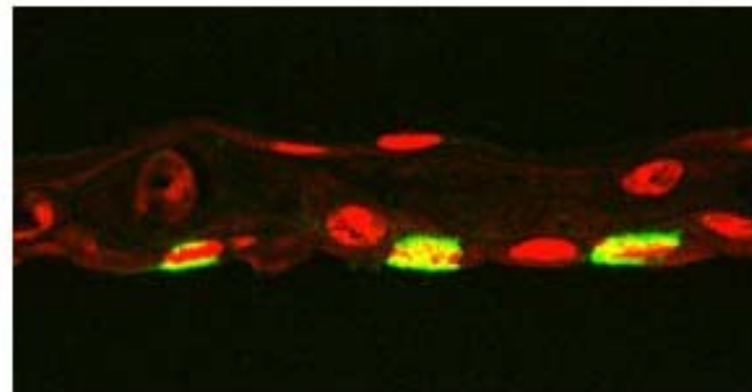
Harvesterd Human Corneal Epithelial Sheets



BrdU

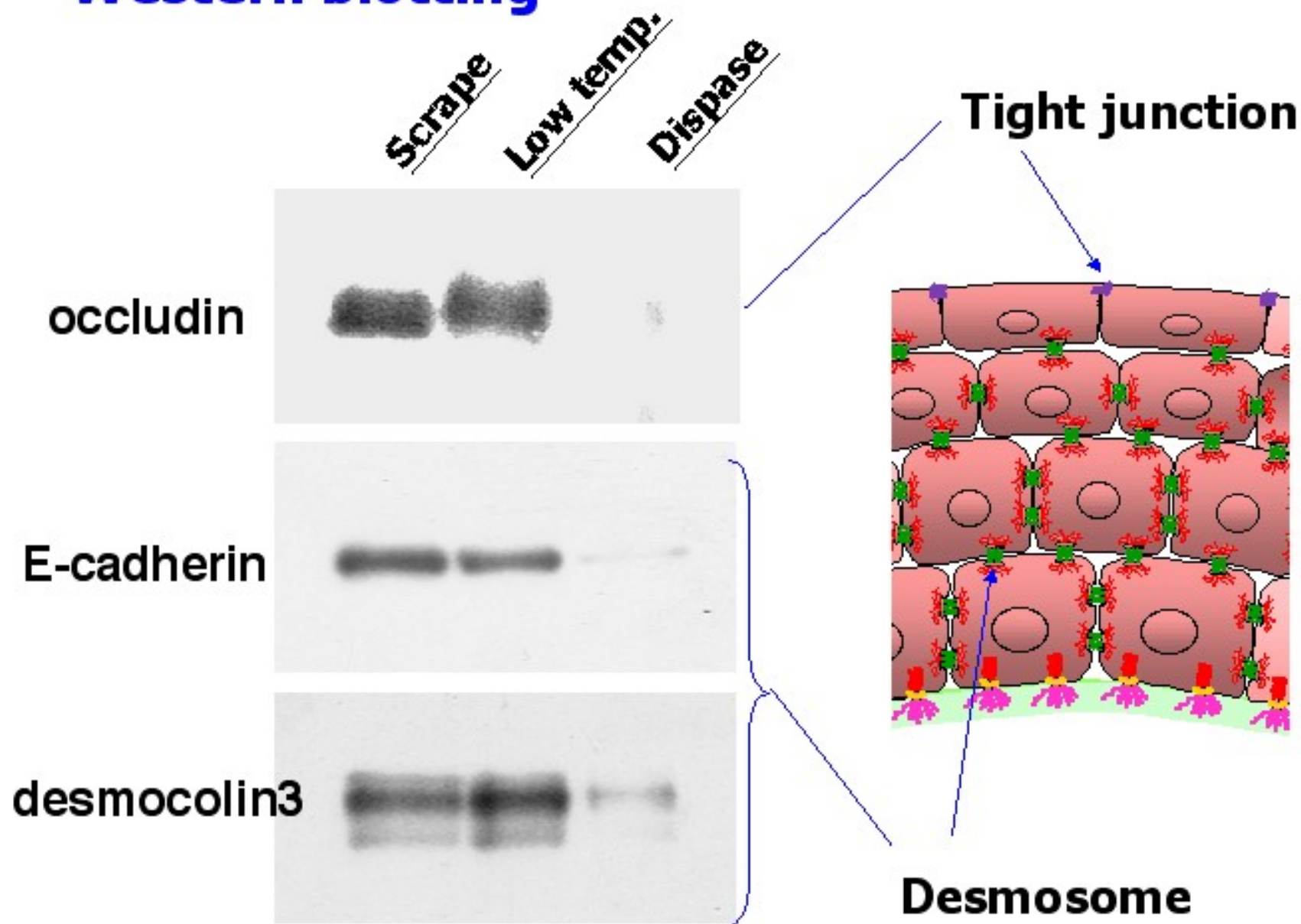


K3

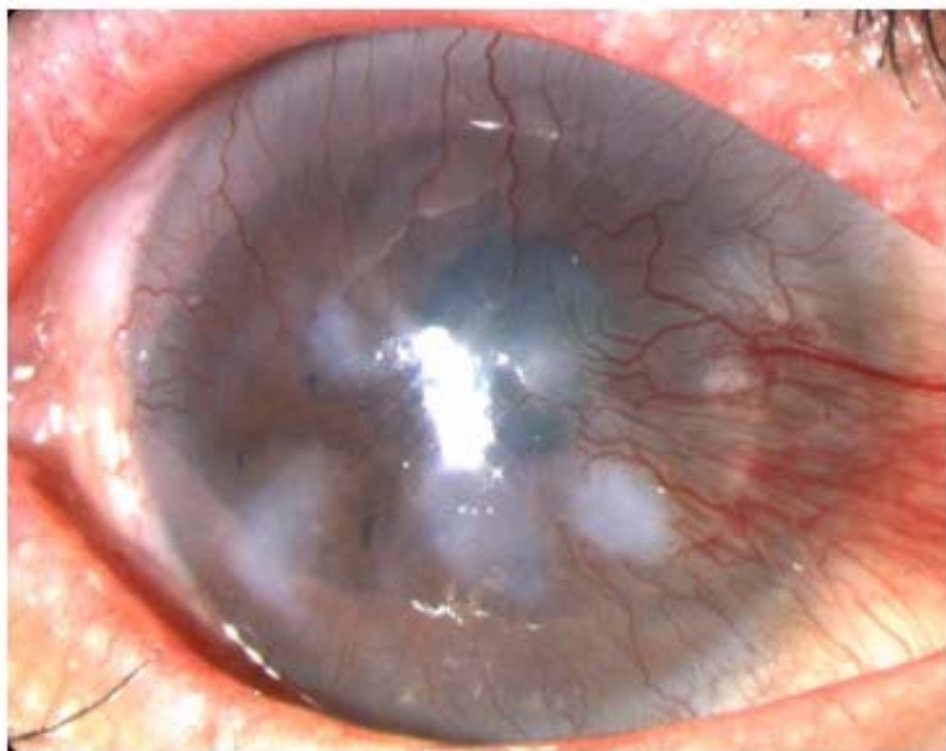


BrdU

Western blotting



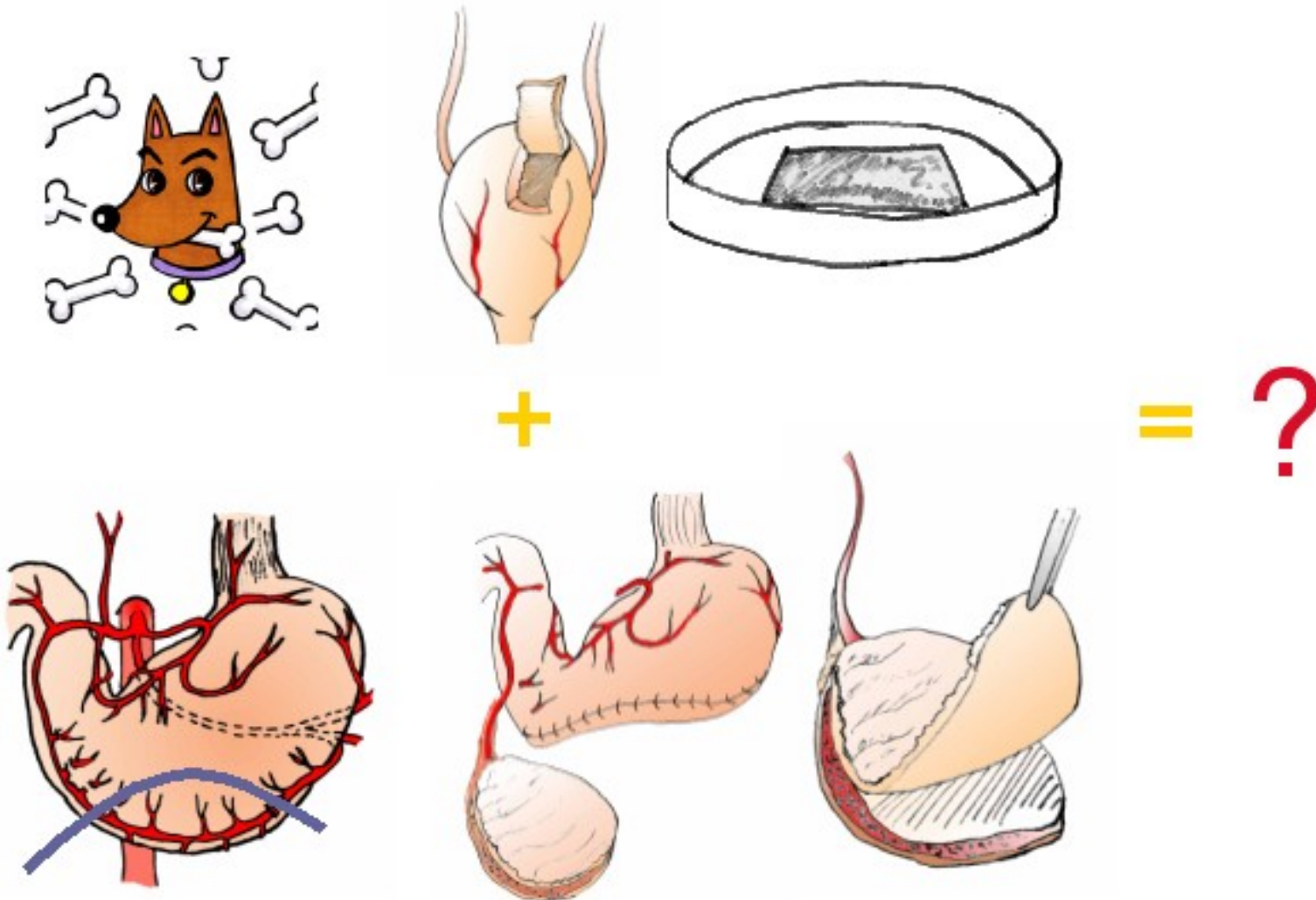
Pre-Ope



1-Month Post-Ope



Mucosal Replacement with Cultured Urothelial Cell Sheets



Urothelial Cell Sheets

Harvested from Temp.- Responsive Dishes



**mono-layer
domain**

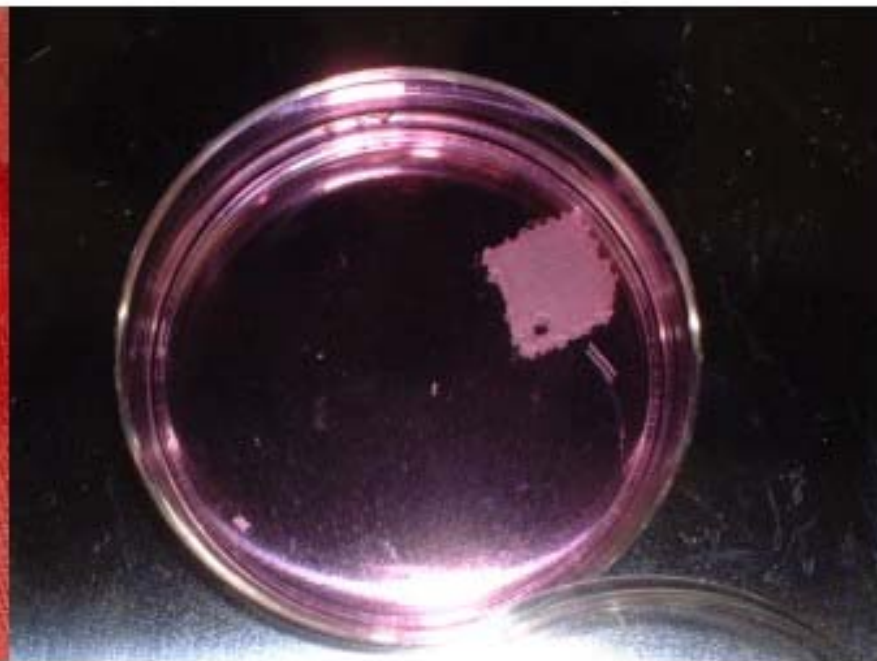


**multi-layer
domain**

Autotransplantation of Urothelial Cell Sheets onto Demucosalized Stomach Flaps



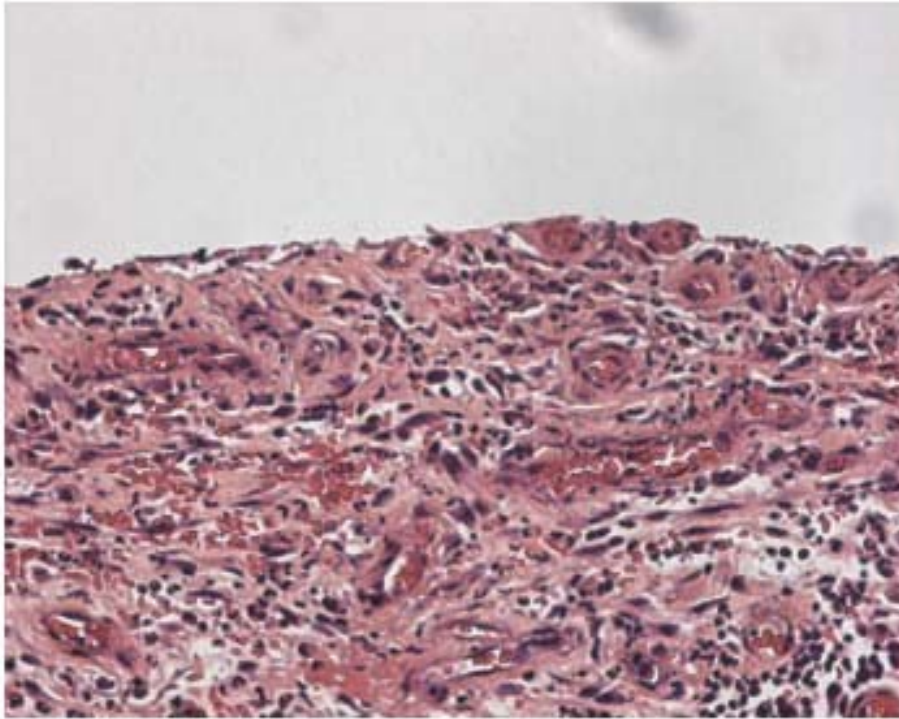
**demucosalized
stomach flaps**



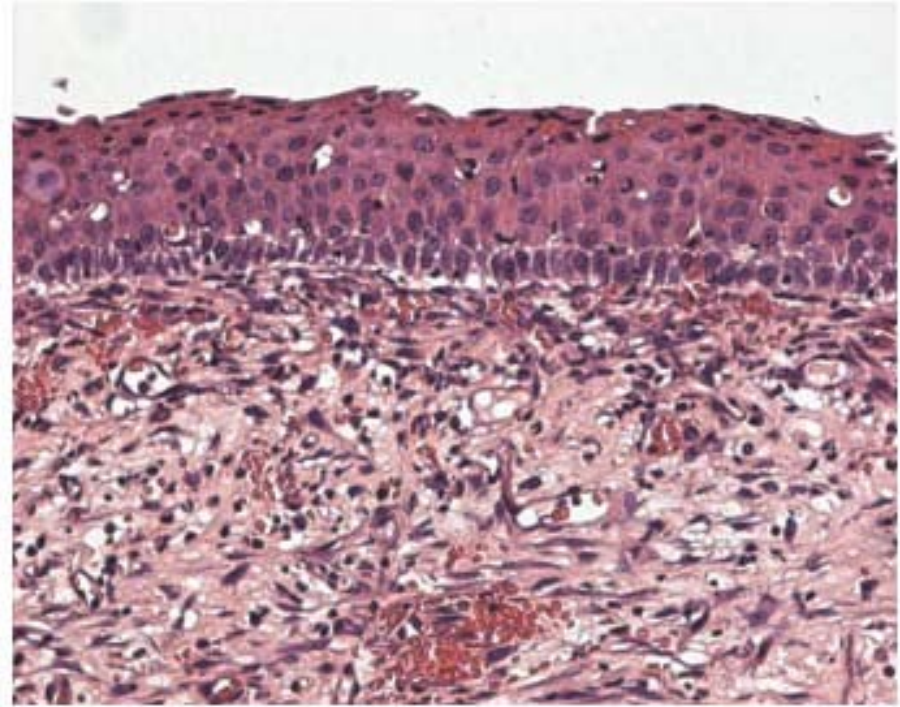
harvested cell sheets

Regenerated Urothelium

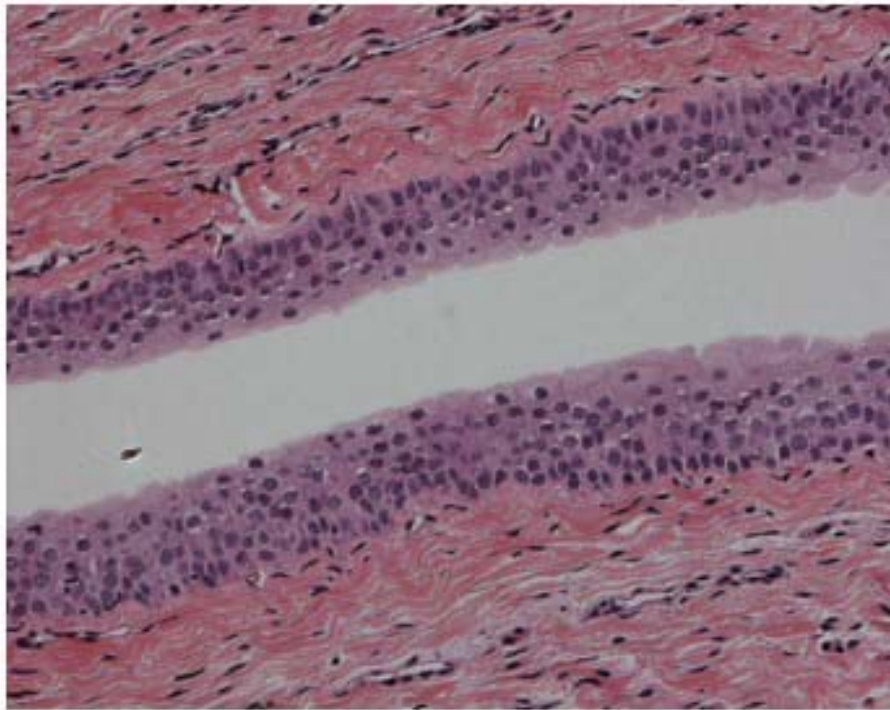
3-Week after Autotransplantation



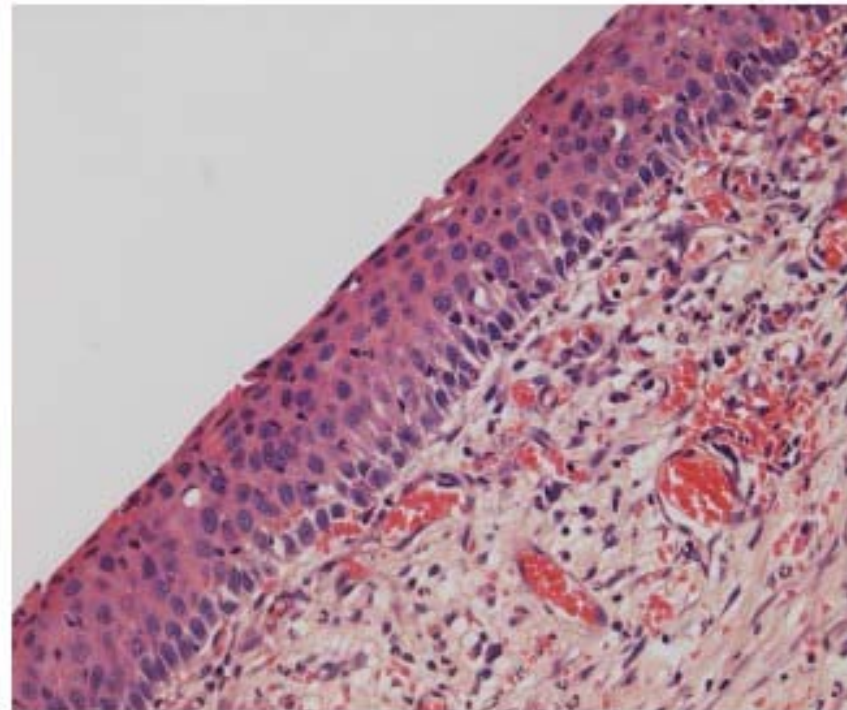
without cell sheets



with cell sheets

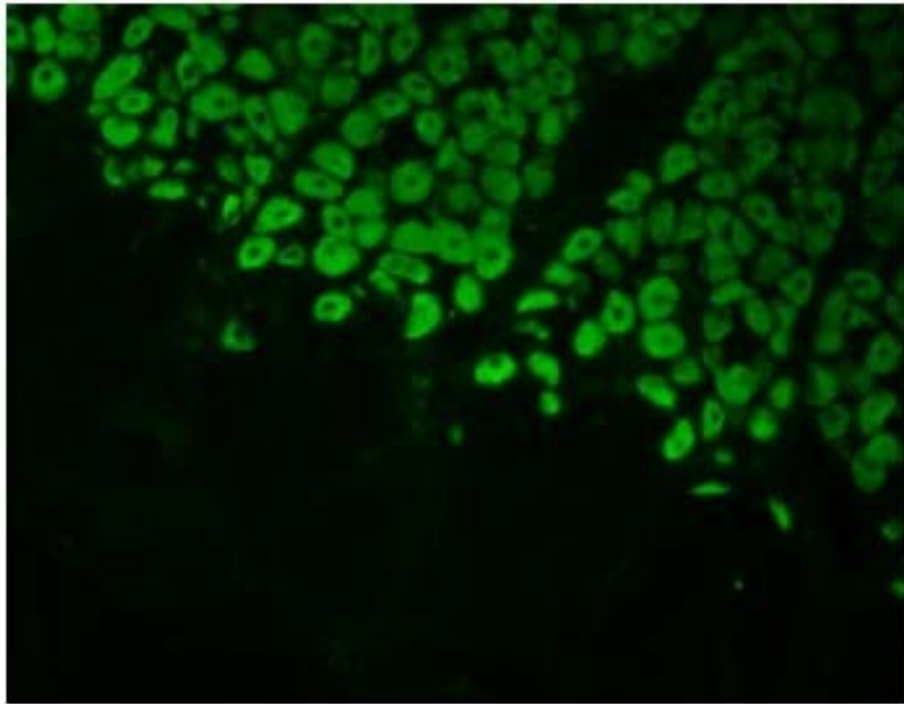


Native Ureter

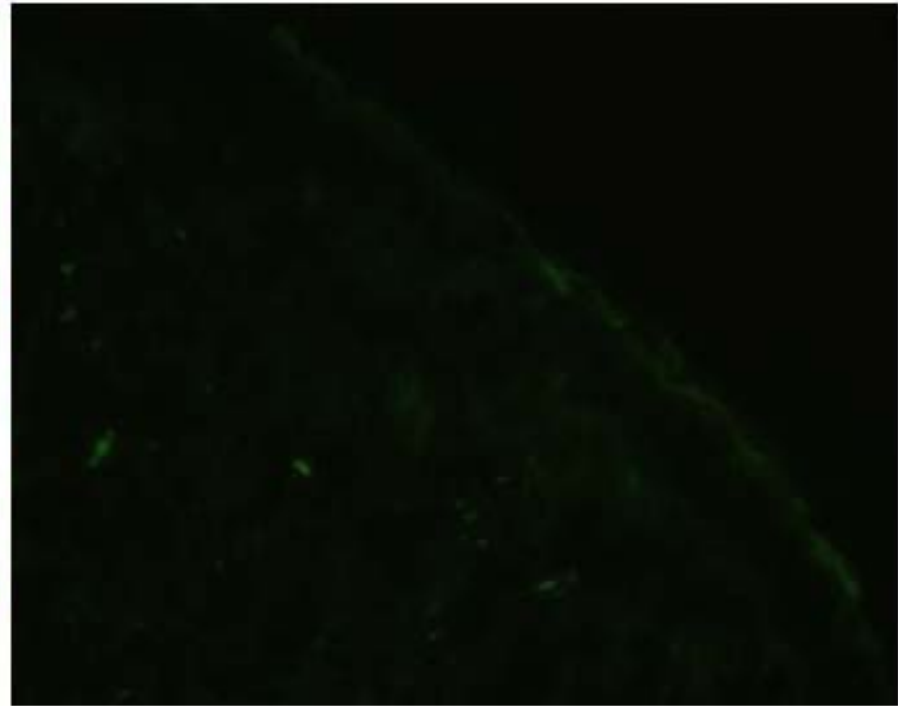


**Regenerated
Urothelium**

Stomach Proton Pump- **Staining**

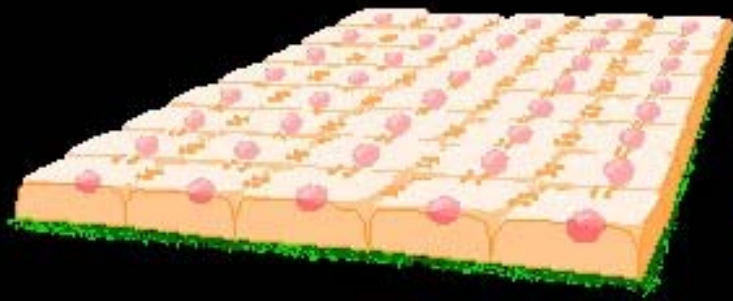


native stomach

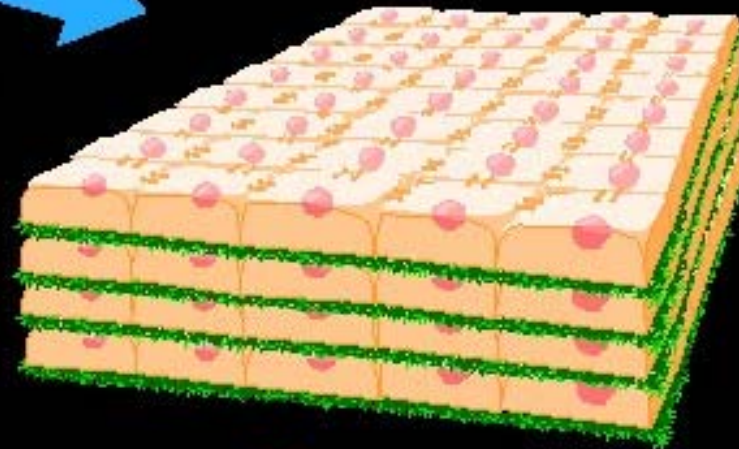


**regenerated
urothelium**

Stratify Layer by Layer

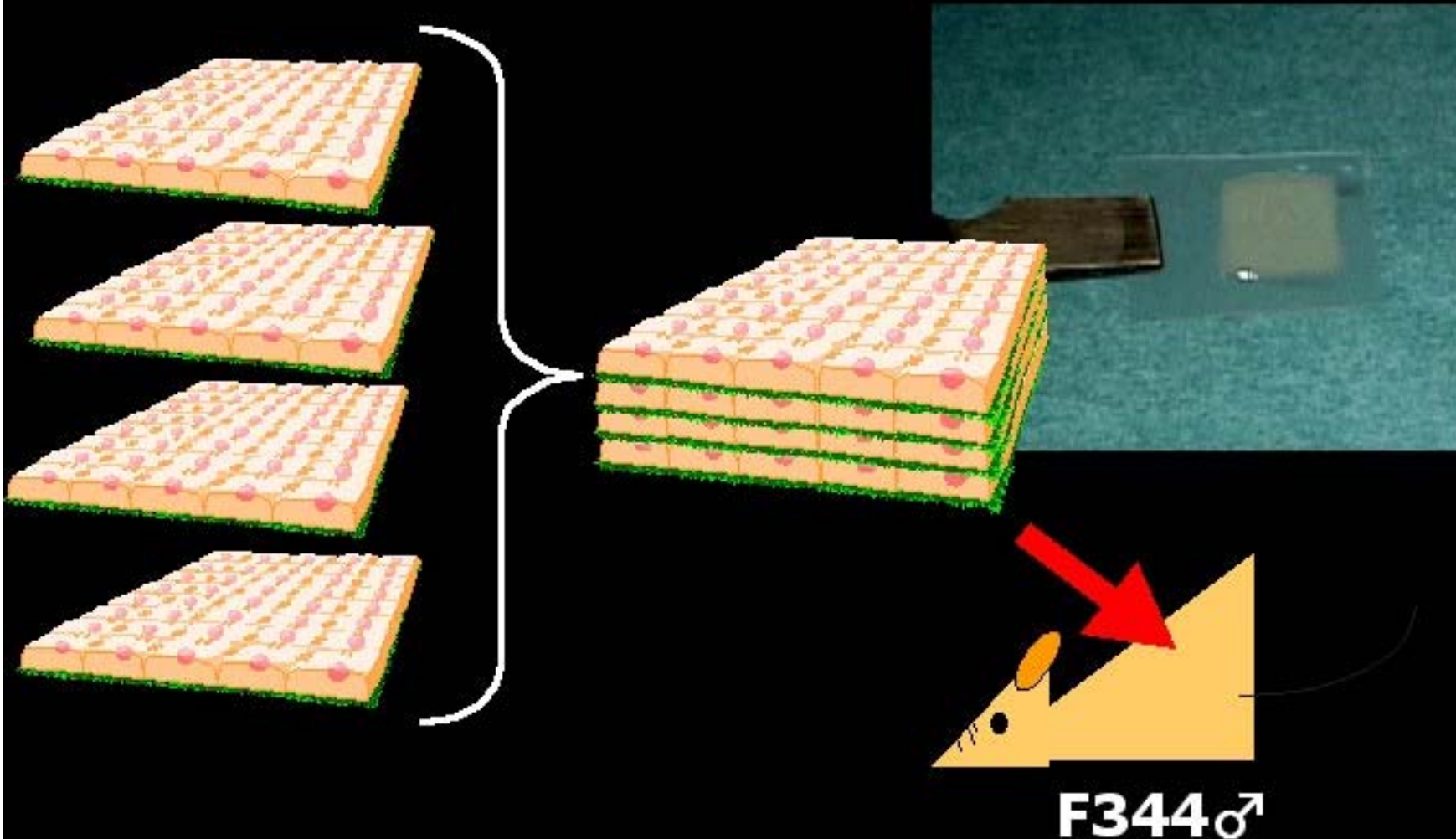


cardiac myocyte sheet

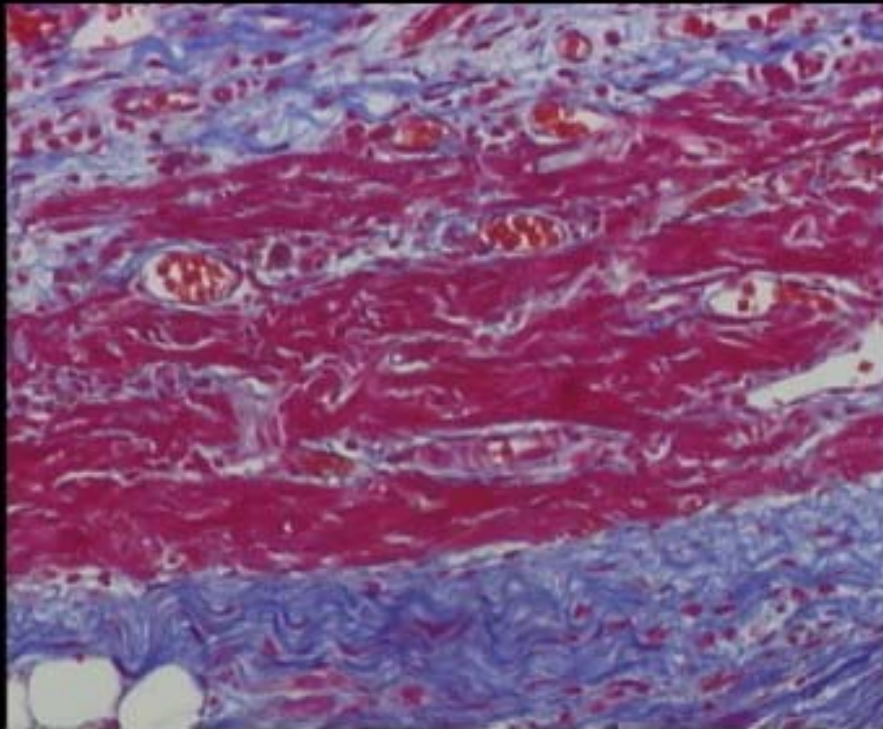


cardiac patch

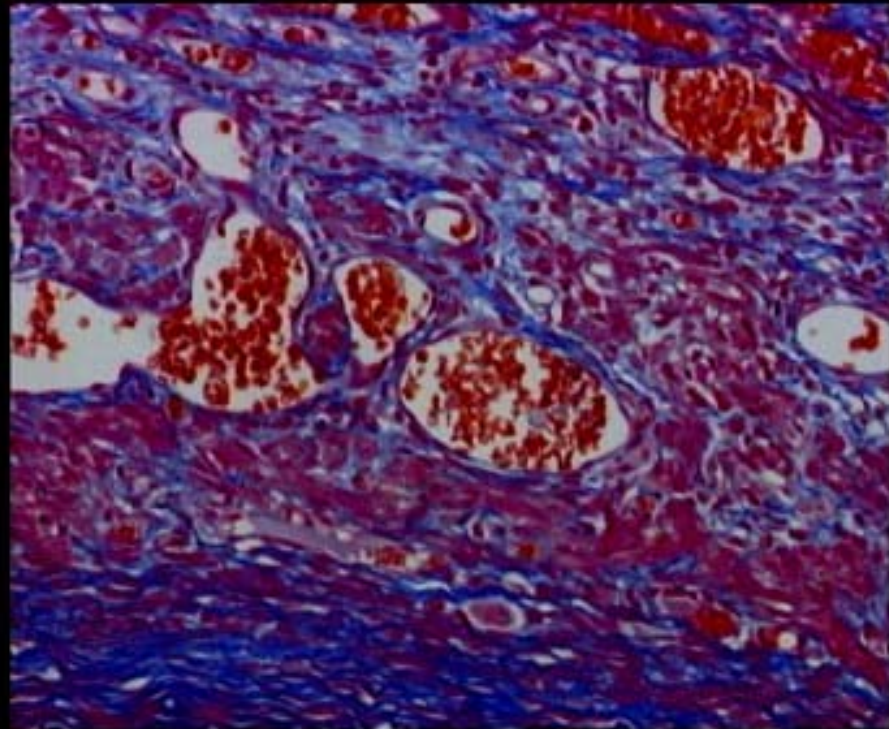
Subcutaneous Transplantation of Cardiac Patch



Polysurgery Prevents Necrosis of Thick Grafts



**3-sheet graft
+
3-sheet graft**



**6-sheet graft
at one time**

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